# THE MINERAL RESOURCES OF BULLER COUNTY

By

J.M. Hope, Mining Engineer,
Mines Dept,
Greymouth.

D.J. Young, Geologist,
N.Z. Geological Survey,
Greymouth.

*One of the most notable scenic attractions of the Buller district is the Buller River and Gorge which provide many easily accessible spots for the roadside picnic and the followers of all water sports.*

Robin Mitchell
$6·50

# Foreword

BY THE MINISTER OF MINES,
HON. T. P. SHAND

I congratulate those responsible for undertaking the preparation and distribution of this publication describing mineral and other resources of the Buller County.

Although intended primarily for visitors to the Eighth Mining and Metallurgical Congress to be held in Australia and New Zealand in April of this year, the booklet will provide a valuable reference work for all who are concerned about our country's resources.

It is encouraging to see that the spirit of self-help is alive in your district, for nothing but good can come from making known to others what you have to offer in the way of resources and facilities.

The Government has been glad indeed to help by arranging for officers of the Geological Survey, Mines Department and Department of Tourist and Publicity to assist in providing material which, I know, will be useful and informative.

My best wishes to all associated with this work.

T. P. Shand.

Minister of Mines
17 March 1965

Acknowledgements

This booklet has been published with the practical help and kind assistance of the Hon. Mr T. P. Shand, Minister of Mines, Mr P. Outhwaite, under-secretary of Mines, Mr L. Jones, chief inspector of Mines, Mr R. Willett, Director of Geological Survey, Mr E. M. Horan, Government Publicity Division, Mr J. M. Hope, Mines Department, Mr D. Young, Geological Survey, and Mr Peter Roselli, public accountant, to whom the chamber's thanks and appreciation are extended. Also Mr R. A. Spowart of the Westport News who edited this copy, our grateful thanks.

B. S. Scott, President,
Buller Chamber of Commerce.

## INTRODUCTION

The presence of large areas of Precambrian basement greywacke and argillite, of granite and granitoid rocks, and of Jurassic, Cretaceous, and Tertiary terrestrial and marine sediments, makes Buller County one of the most geologically interesting in New Zealand.

This publication is designed to provide the interested with simple background information concerning some of the more important minerals of the County, along with a short bibliography from which more detailed information can be obtained.

## METALLIC MINERALS

### Copper and Molybdenum

Copper-molybdenum mineralization is known in the Buller County at Mt Radiant in the headwaters of the Little Wanganui River, and at Cascade Creek, a tributary of the Buller River. Copper mineralization has also been reported in the Mt Glasgow area.

At Mt Radiant a north-west striking belt of metasediments (hornfels, schist, gneiss) occurs within biotite granite, and copper-molybdenum mineralization has occurred in the vicinity of the granite-metasediment contact (Wodzicki, 1960). Pegmatite intrusions are common, and lamprophyric dykes also occur in the area.

Most of the lodes lie within half a mile of the granite-metasediment contact. The chief gangue mineral is quartz but potash feldspar occurs in some lodes. Sericitization and chloritization of the wall rocks is common. The ore minerals are pyrite, chalcopyrite, bornite, tetrahedrite, and molybdenite. The lodes strike in two directions paralleling the joint system of the enclosing rocks.

The Mt Radiant lode has been prospected by underground methods and found to be of low grade and small extent. Available analyses (Webb, 1910) suggest that the average grade is approximately 1% copper and 0.1% molybdenum. All other known lodes also appear to be small low grade lenses.

Lowgrade copper-molybdenum mineralization occurs at Quartz Creek, a tributary of Cascade Creek, in a system of quartz reefs averaging about one foot in width which are emplaced in sheared

Greenland greywacke and argillite. The principal ore mineral is molybdenite, with some chalcopyrite and traces of gold and silver.

Copper mineralization has also been reported in Waiuta greywacke in the Mt Glasgow Range near the Mokihinui River.

References:
WODZICKI, A. 1960: Geology and Mineralization of the Mt Radiant Area, North West Nelson, New Zealand. N.Z.J. Geol. & Geophys. 3 (3) 355-363.

## Gold

### Metalliferous Quartz Veins

Metalliferous quartz veins occur in greywacke and argillite of the Greenland and Waiuta Groups which form parts of the basement complex in Buller County. The two groups are distinguished only by differences in their strikes; the Greenland Group striking north-west and the Waiuta Group north-east. Dips are generally steep in both groups which are isoclinally folded.

Quartz veins are fairly numerous, usually thin, and almost invariably lenticular. The quartz frequently shows moderate staining by iron oxides and contains a little pyrite and occasionally other sulphides. Gold is the only constituent of economic importance but many veins are barren.

Considerable quantities of gold have been won from reefs in three areas; Lyell Stream, Mokihinui River and Waimangaroa.

LYELL STREAM -- Quartz mining at Lyell Stream commenced in 1870. Several mines were developed, the most important in the field being the United Alpine which operated from 1880 until 1912 and produced 80,510 oz of gold from 146,640 tons of ore (Downey, 1928).

The veins at Lyell Creek occur in Waiuta greywacke. At the United Alpine mine two ore shoots were worked in the upper levels, the main vein being 50 feet wide. Very little ore was found below No. 6 level. The other mines worked small but rich veins, some of which were only two or three inches wide.

MOKIHINUI RIVER -- Auriferous quartz veins were discovered in Waiuta greywacke in the Mokihinui River about 1875. Several mines were developed but only the Red Queen met with any measure of success. It produced 3014 oz of gold from 2208 tons of ore. The veins in the Mokihinui district are generally small and lenticular, and conform with the bedding of the greywacke and argillite.

WAIMANGAROA -- Gold bearing quartz veins were discovered in Greenland greywacke in the watershed of Stony Creek in 1875. The two most important mines were the Great Republic and the Britannia. The Republic mine worked a lode varying from 3 feet to 7 feet wide which dipped westwards at 45 degrees in loose and broken country. The total value of the gold won was £12,000. The Britannia Company worked a number of lenticular veins which were rich but small and usually 6 inches to 3 feet wide.

Other localities where auriferous quartz veins have been found include New Creek, Mackley River, Burnetts Face, Cascade Creek and Oparara River.

Alluvial Deposits -- Large quantities of gold have been produced from late Quaternary blacksand leads which lie on or in a series of terraces rising to a height of nearly 600 feet along the coast. At least six of these have been worked for gold near Charleston. The leads are lenticular and have a linear arrangement parallel to the ancient shorelines. Minerals present in the blacksand other than gold include ilmenite, garnet, zircon, monazite, chromite and platinum. Important localities were Fairdown, Addisons Flat, Croninville, Charleston and Four Mile Creek.

The banks and beds of many of the streams in the County have been worked for gold, the most important areas being the Buller River at Tiroroa, Berlins, Three Channell Flat, New Creek, Blackwater River, Cascade Creek, Whareatea River, Waimangaroa River, and Rough and Tumble Creek.

Recent beaches have been worked at many places.

References:

DOWNEY, 1928: Quartz Reefs of the West Coast Mining District, N.Z.

## Ilmenite

Very large reserves of ilmenite are contained in the dune sands and beaches of Buller County.

The most important localities are Nine Mile Beach and Carters Beach between Charleston and Westport,

and the beaches between Little Wanganui River and Kohaihai River near Karamea.

Nicholson et. al. (1958) report surface concentrations of ilmenite and magnetite as follows:

| LOCALITY | GRADE OF SAMPLE | ILMENITE | MAGNETITE |
|---|---|---|---|
| Nine Mile Beach | Surface concentration | 25.5% | 0.9% |
| Carters Beach, Westport. | Surface concentration | 14.6% | 0.4% |
| Seven Miles south Karamea R. | Average surface sand | 8% | N.A. |
| Two miles south Karamea R. | Surface concentration | 8% | N.A. |

These figures show that magnetite is an unimportant constituent of the sand.

A borehole survey of half of Nine Mile Beach (Marshall et. al. 1958) showed that the average percentage of magnetically recoverable ilmenite in the surface sand to a depth of 20 feet is 5.5, and that the reserves of recoverable ilmenite above ground water level are approximately 1,360,000 tons. The same quantity is inferred above ground water level in the southern half of the beach. Extension below ground water level may well double these figures.

Reserves of similar magnitude may also occur at Carters Beach

The consolidated sands along the old coastlines also contain ilmenite in concentrations of up to 50 percent. The material is weathered in many places, and alternation to leucoxene is probable. Recent drilling (Mr B. J. McEnaney, pers. comm.) has also revealed concentrations of up to six percent zircon, and one percent monazite, with small amounts of rutile. Traces of gold, platinum, and tin are also present in the ilmenite sands. The ilmenite assays up to 48% Tio2.

Reserves at Karamea may equal or exceed those at Westport as it is obvious that total reserves of ilmenite in Buller County amount to several tens of millions of tons.

References:
NICHOLSON, D. S; CORNES, J. J. S; MARTIN, W. R. B; 1958: Ilmenite Deposits in New Zealand. N.Z.J. Geol. & Geophys. 1:611-616.

MARSHALL, T; SUGGATE, R. P; NICHOLSON, D. S; 1958: A Borehole Survey of Ilmenite-Bearing Beach Sands at Cape Foulwind, Westport. N.Z.J. Geol. & Geophys. 1:318-324.

## Lead

A lode containing antimony and galena has been reported in Cascade Creek (Cox, 1877).

References:
COX, 1877: G. S. Rep. 1874-76. No. 9.

## Molybdenum

(See Copper section).

## Uranium

Three areas containing uranium mineralization of possible economic importance have been discovered in Buller County. In each of these areas the host rock for uranium mineralization is Hawks Crag Breccia of Jurassic age, but in the Punakaiki area shales and sandstone that conformably underlie the Breccia are also uraniferous.

BULLER GORGE -- A basement of Greenland sediments, (hornfelsic greywacke, phyllite, schist) and granitic rocks (granite, diorite, and gneiss) is unconformably overlain by a sedimentary sequence of shale, sandstone, and breccia.

Intrusive quartz porphyry is part of the basement complex, but other younger intrusive porphyries and lamprophyres cut the sedimentary sequence.

The sediments, known as the Porarari Group, include the Ohika beds and the Hawks Crag Breccia (Bowen, 1964). The Ohika beds, which rest unconformably on the basement, consist of a basal conglomerate, fissile shales, carbonaceous mudstone, vitric tuffs, and quartzose sandstones.

The Hawks Crag Breccia overlies the Ohika beds unconformably and has been divided (Beck et. al. 1958) into four facies. The Tiroroa A and B facies beds consist of predominant sub-rounded granite boulders and rare angular greywacke fragments set in an arkosic matrix containing intercalated lenses of grit, sandstone and carbonaceous material. The Dee Point facies consists almost entirely of angular greywacke fragments set in a fine-grained ferruginous matrix; the Blackwater facies has a mixed

granite-greywacke composition. Uranium occurs in the Tiroroa A and B facies and in the zone of interfingering with the Dee Point facies.

The primary uranium mineral (coffinite) occurs as a fine grained mixture with pyrite and carbonate in the matrix. The mineralized beds commonly contain carbonaceous material. Feldspars, when present, are always stained a characteristic red due to hematization. Pyrite and purple fluorite-barite veins have been observed. Secondary uranium minerals are not common but autunite and uranophane have been identified.

Radioactive outcrops in the Tiraroa facies A beds extend through 1000 feet of stratigraphic thickness. At least 10 horizons are known ranging in width from a few inches to several feet. The stratigraphically lowest horizon is the most extensive and radioactive outcrops have been found along it for 3500 feet although no continuous exposure for more than a few tens of feet is known.

Mineralization is conformable with the poorly defined bedding but varies rapidly and erratically in both width and grade over short distances along the strike. The highest assay recorded is 6.4% $U_3O_8$ but this is from one locality only where neither the grade nor the width persists for more than a few feet (Hope et. al. 1959). Generally the grade is less than 1.5% $U_3O_8$.

PUNAKAIKI -- At Punakaiki the greywacke basement is unconformably overlain by a sedimentary sequence which grades up from interbedded shale and sandstone at the base (Porarari Formation), to granite breccia (Hawks Crag Breccia) which in turn grades

upwards into sandstone and grit of the Topfer Formation.

Uranium mineralization (uraninite) occurs in both the Hawks Crag Breccia and in the Porarari Formation. There is no visible difference between the mineralized and non-mineralized rock.

At least 16 uraniferous horizons are known within the Porarari Formation, three of which have been traced for more than 100 feet along the strike, and one for 400 feet. There are no sharply defined hanging or footwalls; and, as in the Buller Gorge, mineralization is irregular in width and grade.

More than 50 uranium occurrences have been located in the overlying Hawks Crag Breccia where mineralization is similar to that in the Tiroroa facies of the Buller Gorge. No occurrence has been traced for more than a few tens of feet along the outcrop.

FOX RIVER MOUTH -- Hawks Crag Breccia crops out for a distance of 15 chains along the beach immediately south of Fox River mouth. The breccia consists of thick conglomerates carrying granite boulders in a gritty matrix with lenses of sandstone, siltstone, and carbonaceous material. The upper 200 feet is leached and the feldspars have decomposed and have been removed. Radioactivity is confined to carbonaceous layers and streaks.

References:

BECK, A. C; REED, J. J; WILLETT, R. W; 1958: Uranium Mineralization in the Hawks Crag Breccia of the Lower Buller Gorge Region, South Island, New Zealand. N.Z.J. Geol. & Geophys. 1:432-50.

BOWEN, F. E., 1964: Sheet 15 Buller (1st Ed.).

Geological Map of New Zealand. 1:250,000. D.S.I.R. Wellington, N.Z.

HOPE, J. M; HOGG, W. J; DONALD, J. A., 1959: Uranium Areas of New Zealand. Proc. Fourth Triennial Min. Conf. Dunedin School of Min. & Met. Paper 180.

## FUELS

### Coal

Messrs Charles Heaphy and Thomas Brunner made the first discovery of coal in the Westport district when they observed a denuded outcrop of lignite near Nile River in 1846 (Morgan & Bartrum, 1915).

John Rochfort found pieces of bituminous coal in the Waimangaroa River in 1860, and two years later Dr Julius von Haast found a seam of bituminous coal in the upland country near Denniston.

Coal mining began about 1863, but met with little success until 1880 when the Westport Colliery Company (later the Westport Coal Company) commenced operations near Denniston. Since then coal mining, centred on Stockton and Denniston, has become the chief industry of Buller County.

Annual outputs climbed steadily from 5272 tons in 1880 to a maximum of 831,200 tons in 1910. Production has since declined irregularly to 257,807 tons in 1963. The total production from the County to the end of 1963 was 35,807,699 tons.

Coal Measures outcrop near Charleston in the south, in the Buller Gorge near Berlins and Inangahua Junction, in the upland country between Buller River and Seddonville, and in several localities near Karamea and the Heaphy River.

They are Eocene in age and are generally less than 150 feet thick, but locally may exceed 200 feet. They rest unconformably on Paleozoic basement rocks, and are overlain by upper Eocene marine beds (Kaiata Formation). Usually only one seam is workable, and in the producing areas the coal is often slightly weathered not only at the outcrop but well within the mines. This is due to the thin cover and the multitude of joints that have permitted water seepage. The coal seams vary from 0 to 60 feet in thickness, and where the coal is thick the overburden to coal ratios are usual for opencast mining. The coal varies in rank from lignite (Charleston) to low volatile bituminous (Waimangaroa).

High swelling coals occur in a narrow belt extending north-east from Mt Rochfort through Denniston, and Stockton, to the Ngakawau River, more or less along the axis of the Paparoa Anticline. Depth of burial has been accepted as the factor controlling rank, and the present anticline, having the highest rank coal, thus represents the region most deeply depressed during the depositional period. Away from the anticline the rank progressively decreases through high volatile bituminous, to sub-bituminous and lignitic coals. The sulphur content also varies laterally from 0.5 percent to more than 6 percent.

Frequently the sulphur is concentrated near the roof and floor of the seam, but in some cases it is irregularly distributed. In some areas where the coal is thick (e.g. No. 2 Block, Stockton) the ash content is remarkably low, the minimum recorded figure being 0.2 percent. Several million tons of reserves containing less than one percent ash are known.

The Buller coals are of different type from British coals and have higher hydrogen contents, higher volatile contents, and greater swelling properties. The high rank coals along the Mt Rochfort anticline have British Crucible Swelling Numbers of 9 and 9+, and volatile contents of 30 to 35 percent.

Most of the production in the County has been coal of bituminous rank from the Denniston, Stockton, and Seddonville areas. Small outputs of lignite and sub-bituminous coals are obtained in the Buller Gorge and Charleston areas.

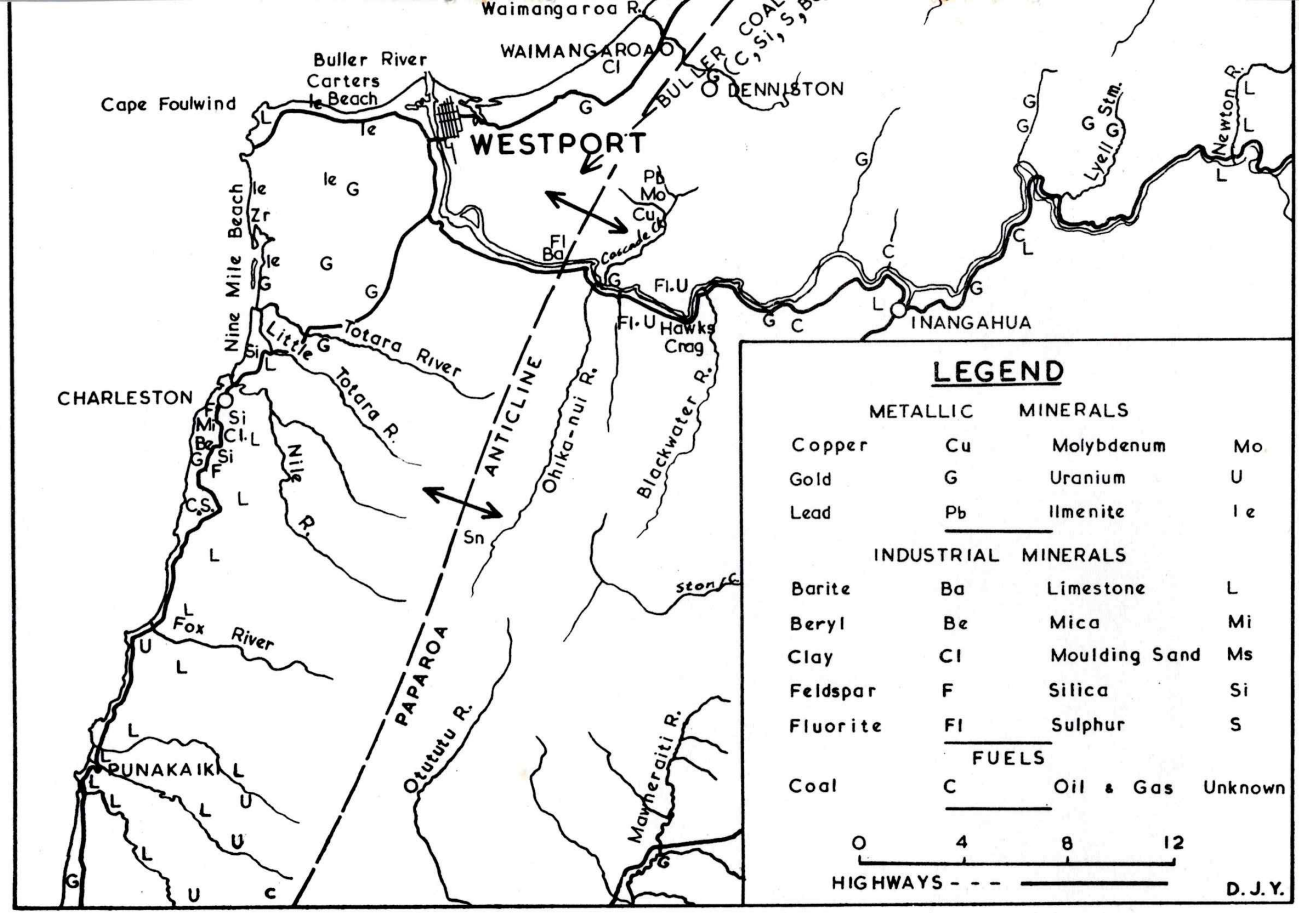
Reserves of recoverable coal of the various ranks are given in Tables 1 to 3:

TABLE 1: LIGNITE

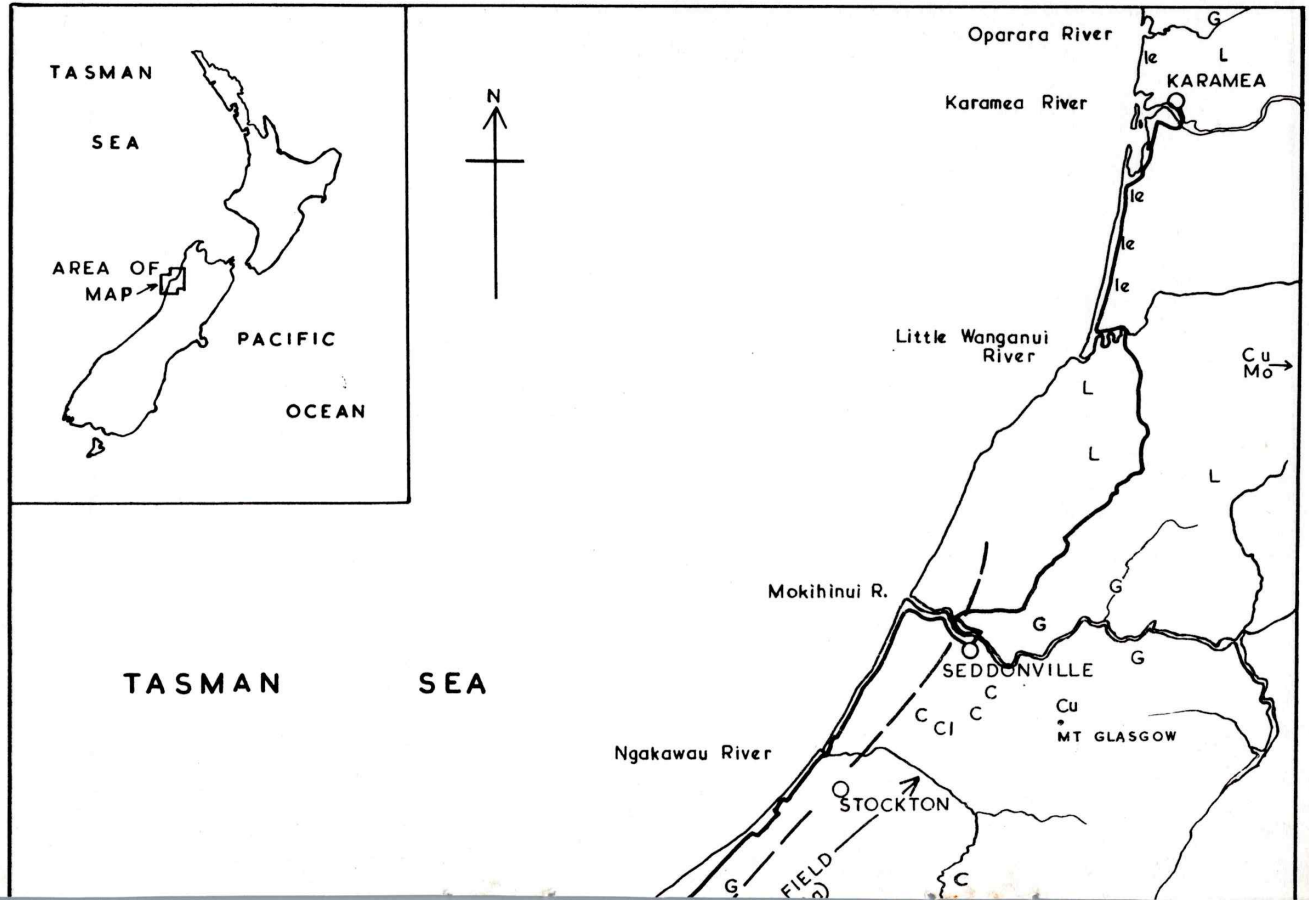
| MEASURED COAL Tons | INDICATED COAL Tons | INFERRED COAL Tons |
|---|---|---|
| Charleston 6,000,000 | 2,000,000 | 8,000,000 |
| Total: 16,000,000 tons | | |

TABLE 2: SUB BITUMINOUS

| AREA | MEASURED COAL Tons | INDICATED COAL Tons | INFERRED COAL Tons |
|---|---|---|---|
| Buller Gorge | 100,000 | 2,000,000 | 8,000,000 |
| Heaphy River | - | - | 1,000,000 |
| Total: 11,100,000 tons | | | |


Waimangaroa R.
WAIMANGAROA
Cl
Buller River
Carters Beach
Cape Foulwind
WESTPORT
DENNISTON
BULLER COAL
Pb Mo Cu
Fl Ba
Cascade Cr.
Fl.U
Hawks Crag
INANGAHUA
Lyell Stm.
Newton R.
Nine Mile Beach
Zr
Little Totara River
Totara R.
CHARLESTON
Mi Be Si Cl. L
F
C.S.
Nile R.
Sn
PAPAROA ANTICLINE
Ohika-nui R.
Blackwater R.
Fox River
PUNAKAIKI
Otututu R.
Mawheraiti R.
LEGEND
METALLIC MINERALS
Copper Cu
Gold G
Lead Pb
Molybdenum Mo
Uranium U
Ilmenite Ie
INDUSTRIAL MINERALS
Barite Ba
Beryl Be
Clay Cl
Feldspar F
Fluorite Fl
Limestone L
Mica Mi
Moulding Sand Ms
Silica Si
Sulphur S
FUELS
Coal C
Oil & Gas
Unknown
0 4 8 12
HIGHWAYS
D.J.Y.

# BULLER DISTRICT



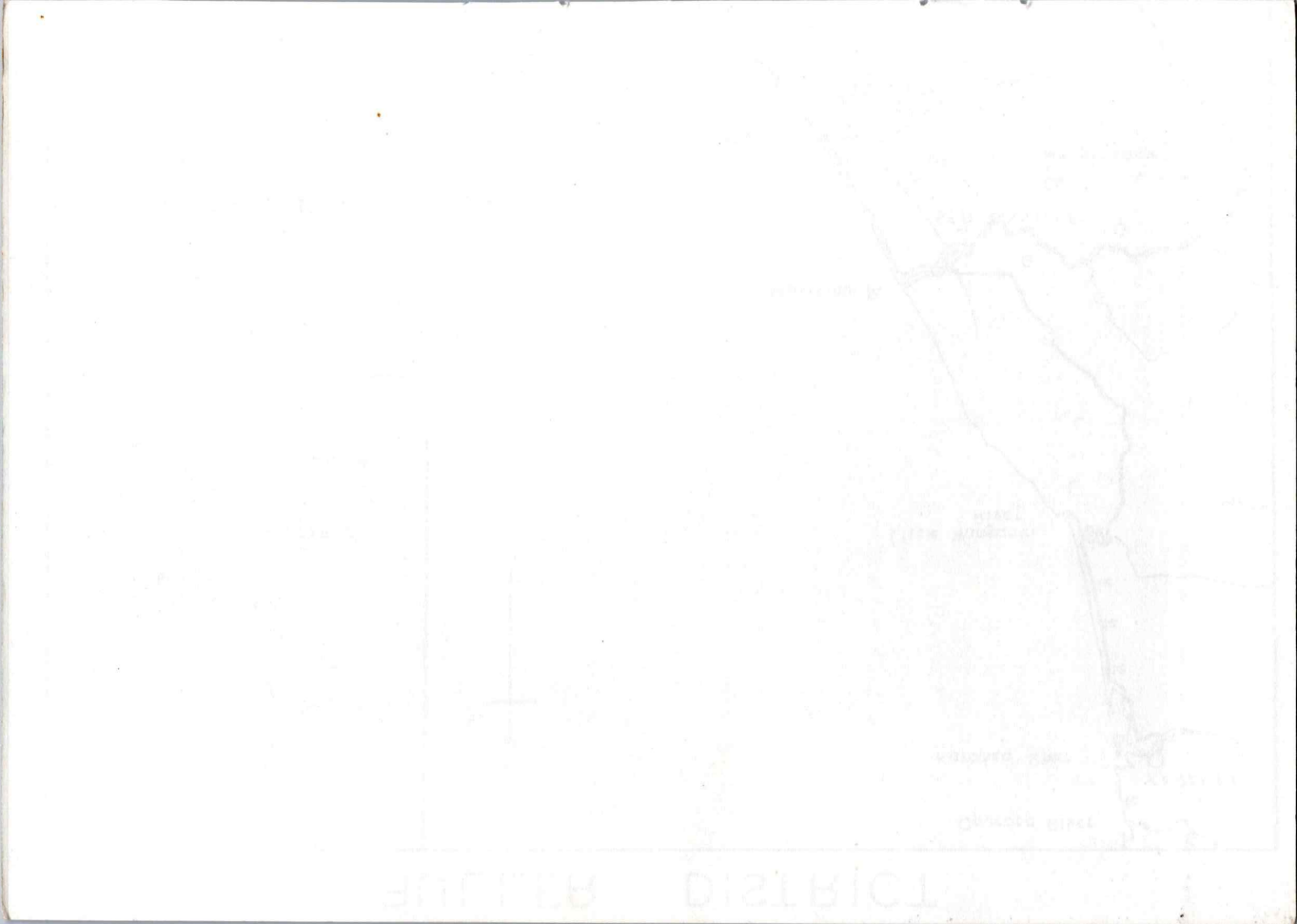


TABLE 3: BITUMINOUS

| AREA | MEASURED COAL Tons | INDICATED COAL Tons | INFERRED COAL Tons |
|---|---|---|---|
| Denniston | 2,893,000 | 1,335,000 | —— |
| Stockton-Millerton | 18,870,000 | 7,150,000 | 15,900,000 |
| Seddonville | 500,000 | 250,000 | —— |
| Total: 46,498,000 tons | | | |

Table IV lists reserves of low sulphur, low ash coals.

TABLE 4: LOW SULPHUR, LOW ASH

| AREA | TONS RECOVERABLE COAL d.a.f. Measured | Indicated | Inferred | SWELLING No. | VOLATILE Percent | SULPHUR Percent |
|---|---|---|---|---|---|---|
| No 2 Block | 2,470,000 | | | 9-9+ | 30-35 | 0.4-1.0 |
| Mt Frederick | - | 2,205,000 | - | 9-9+ | 27-35 | 0.6-1.0 |
| Denniston | 1,400,000 | | | | | |
| Total: 6,075,000 tons | | | | | | |

References.

MORGAN, P. G; BARTRUM, J. A. 1915: The Geology and Mineral Resources of the Buller-Moki-

hinui Subdivision, Westport Division N.Z. Geol. Sury. Bull 17.

SUGGATE, R. P. 1959 New Zealand Coals, D.S.I.R. Bull. 134.

## Petroleum and Natural Gas

Neither oil nor natural gas occurrences have been reported to date in Buller County, but the presence within its borders of a thick Tertiary sequence, even though large scale structures appear to be absent, suggests that small deposits could be present.

## INDUSTRIAL MINERALS

### Barite

Barite occurs as small irregular veins two or three inches wide in quartz porphyry near the Coalbrookdale Tunnel on the old roperoad from the Whareatea mine to Denniston.

Several groups of small barite veins occur in the Brunner coal measure sandstones and grits on the Millerton-Stockton plateau. The veins vary from a fraction of an inch to six inches in width and cannot be traced for more than a few tens of feet. The dip is nearly vertical and most veins strike in north westerly directions. Barite veins have also been encountered in the coal seam at Fly Creek mine.

Veins of barite and fluorite occur in granite-gneiss at Mispickel Creek in the Buller Gorge and in Hawks Crag Breccia near Tiroroa also in the Buller Gorge. The Mispickel Creek vein is emplaced along a fault, is about two feet wide and contains

barite, white fluorite, quartz, finely disseminated pyrite, and a radioactive mineral thought to be coffinite. The veins in the Hawks Crag Breccia contain purple fluorite and are both cross cutting and conformable.

None of these occurrences has any economic value.

References:

COX, 1877: G. S. Rep. 1874-76. No. 9.

## Beryl

Pegmatites at Charleston, discussed in the Feldspar section of these notes, also contain occasional beryl crystals up to six inches in diameter.

## Building Stone

Although, so far as is known not at present utilised, some deposits of granite, particularly those containing large, pink feldspar crystals, would make very attractive building stone. The occurrence of boulders of orbicular granite in the Oparara River, near Karamea, could also be used for this purpose if found in sufficient quantity.

## Clay

Clays of Buller County can be conveniently divided into the following four groups of different ages:

1. Recent Pakihi Swamp Clays - These clays are unweathered and of very recent origin, with deposition probably still occurring at the present time in the deeper parts of the swamps. Boring in the region

of Waimangaroa has proved clay thicknesses of up to 14ft with negligible overburden.

2. Marine Eocene Siltstone - Slightly weathered Eocene siltstone has been used in the past at Waimangaroa for the manufacture of bricks. Although very large quantities of this material are available it has not been found particularly satisfactory, largely because of its variability.

3. Coal Measure Clays and Fireclay - Very little fireclay is associated with the coal seams of the Buller Coalfield, what deposits there are being thin and of poor quality. According to Wellman (1944) much better quality coal measure clays occur at Charleston, where they appear to be confined to the horizon between the coal seam and the basement, on which they often directly rest.

4. Residual Clays - Appreciable weathering of the granite and gneissic basement occurred during the deposition of the Eocene coal measures, and where the basement consisted of rocks high in feldspar very good residual clays were formed. Most of these clays have been eroded from the basement surface, but at Charleston in particular, where pegmatitic intrusions occur, some good deposits have been preserved. The known deposits tend to be somewhat gritty, have a high quartz and mica content, and therefore require washing, but it is quite possible that more suitable deposits exist.

References:

HENDERSON, J. 1943: Fireclay and Ganister in New Zealand. D.S.I.R. Bull. 88.

WELLMAN, H. W. 1944: Westport District Clays. Unpub. Rep. N.Z. Geol. Surv. Greymouth.

## Feldspar

Feldspar as crystals of orthoclase up to four feet in diameter occurs plentifully within pegmatite intrusions of the Charleston District. Small quantities have been mined from Deep Creek, and from the "Old Mica Mine" to the west of Charleston. The following analysis shows the material to be of quite high quality, and because of the large size of the feldspar crystals hand sorting and grading would be relatively simple: $SiO_2$ 64,4%; MgO 0.10%; $Al_2O_3$ 16.8%; CaO Nil%; Total Fe Nil%; $Na_2O$ 2.05%; $K_2O$ 12.90%.

No estimate of the quantity available is possible because neither the number nor the true nature of the pegmatite intrusions is known, there being only a few poor outcrops of basement in this gravel covered area.

Quartz sand at Little Totara River and elsewhere near Charleston contains up to 30% by volume of feldspar and could therefore prove a source of both feldspar and silica in the future.

References:

WELLMAN, H. W. 1945: Feldspar, Deep Creek, Charleston, West Coast. Unpub. Rep. N.Z. Geol. Surv. Greymouth.

YOUNG, D. J. 1964: Ganister and Silica Sand Deposits of the West Coast, South Island. N.Z.J. Geol. & Geophys. 7 (3) 508-524.

## Fluorite

(See Barite section of these notes).

## Aggregate

Rock suitable for road metal, river protection etc, is plentiful.

## Ground Water

Abundant supplies of good quality water are available either from the many streams within the region or from the large area of young alluvial gravel.

## Limestone

Originally deposited over nearly all of the area, limestone is now preserved as moderate to steeply dipping remnants on both flanks of the Paparoa Anticline, as isolated outliers in fault angle depressions and, most importantly, as quite large gently dipping deposits over a distance of thirty miles along the coast from Cape Foulwind southwards to Punakaiki.

The limestone, which is of Oligocene age, is particularly variable, being massive at Cape Foulwind, crystalline towards the east of the area, and flaggy at Punakaiki. Where not crystalline it is generally arenaceous and gritty, with many shell fragments and occasional glauconitic beds. It increases in thickness towards the south from at least 30 ft at Cape Foulwind up to a maximum of about 600 feet at Fox River. At Cape Foulwind, Little Totara River near Charleston, and at Little Wanganui River,

the beds dip gently to the east, but elsewhere dips in excess of 20 degrees are the rule rather than the exception.

The limestone at Cape Foulwind (with the overlying marl) is currently being quarried for cement manufacture. At Newton Flat on the Buller River, and at Little Totara River, it is being quarried for agricultural purposes. The following analyses are typical of the better quality stone from these areas:

| | $SiO_2$ | $Fe_2O_3$ | MgO | $Al_2O_3$ | $CaCO_3$ | $P_2O_5$ | $Al_2O_3$+ $Fe_2O_3$ | Loss on ignition |
|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % |
| Cape Foulwind | 0.85 | – | 0.30 | – | 97.85 | – | 0.50 | 0.15 |
| Nile River, Charleston | 0.60 | 0.67 | 0.70 | 0.35 | 97.80 | 0.022 | – | – |
| Newton Flat | 0.54 | 0.23 | 0.14 | 0.28 | 96.5 | 0.090 | – | 2.1 |
| Little Wanganui | 0.78 | – | 0.10 | – | 96.84 | – | 1.04 | 1.24 |

QUANTITY – The Cape Foulwind deposit contains in excess of 46 million tons of limestone having a $CaCO_3$ content of more than 90% (Willett, 1965), and the Newton Flat deposit, investigated for its possible utilisation in a calcium carbide industry contains about 5,000,000 tons of high grade limestone above river level. The quantity of limestone present elsewhere depends on the quality required, but sufficient analyses are available to suggest that the reserves of high quality limestone are of the order of tens of millions of tons. Not all of this however would be easily quarried, and many areas would be difficult of access.

References:

HOPE, J. M. 1962: Limestones for Calcium Carbide in the Buller. Unpub. Rep., Mines Dept. Dunollie.

MORGAN, P. G. 1913: Cement Materials near Cape Foulwind. N.Z. Geol. Surv. 7th Annual Report: 126-128

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## Marl

Abundant reserves of marl, currently being quarried for the manufacture of cement, occur in the region of Cape Foulwind and as a coastal strip further south.

## Mica

Small quantities of muscovite were mined from pegmatite intrusions at Charleston in 1911 and 1912. The quality of the muscovite obtained, according to Morgan and Bartrum (1915) was not good, very little of the two tons mined being in the form of merchantable sheets. Further exploitation will be dependent

on locating other mica-bearing, coarse-grained, pegmatites in the region.

## Moulding Sand

Scahill and Shannon (1964) recently conducted experiments into the suitability of Charleston sand for foundry moulding purposes when blended with bentonite, and found them particularly suitable where high permeability and low green strength are required.

References:
SCAHILL, T. E. J.: SHANNON, W. T. 1964: A note on Foundry Moulding Properties of Sand from Charleston District, Westport. N.Z.J. Sci. 7:362-66.

## Silica

Silica of variable quality and large quantity in the forms of ganister, lump quartz, and silica sand exists in Buller County.

GANISTER - Thick and accessible ganister and quartzite beds overlie the main coal seam of the Buller Coalfield and are exposed as flat lying deposits over a very large area. The beds vary in thickness from nothing to possibly as much as 15 ft with the average thickness being of the order of 6 ft to 8 ft. The material is very hard, although exposure to the weather after breaking causes the blocks to break down slowly into their constituent quartz pebbles, granules and sand. Much of the ganister is highly micaceous, iron stained, and carbonaceous, and although the silica content ranges up to a maximum of about 95% it is doubtful if much of it has a silica

content in excess of 80%. Its use for the manufacture of firebricks etc. is therefore quite feasible, but more sophisticated industries demanding a large quantity of high quality ore (e.g. ferrosilicon manufacture) could probably not be satisfied from the coalfield ganister deposits.

SILICA SAND - An extensive area of quartz sand up to one and a half miles wide and four miles long is present near Charleston. It occurs in two environments; firstly, in the same stratigraphic position within the Charleston Coal Measures as is the ganister of the Buller Coalfield, and secondly, as this coal measure quartz sand which has been resorted by wind and water during late Pleistocene times. In hand specimen the resorted material is markedly purer than that within the coal measure sequence.

The following analysis from Scahill and Shannon (1964) is for sand from a quarry within resorted quartz sand at Little Totara River, currently being used in the manufacture of cement: $SiO_2$, 94%; $Al_2O_3$, 2.6%; $Fe_2O_3$, 0.2%; MgO, 0.2%; CaO, 0.1%; $Na_2O$, 0.4%; $K_2O$, 2.0%; $TiO_2$, 0.02%; $P_2O_5$, 0.01%; MnO, 0.01%; $H_2O+$, 0.32%.

This shows that the main constituent of the sand is quartz, but the mica and feldspar contents, both at this quarry and elsewhere, are also quite high (up to 3% and 30% respectively by volume).

QUANTITY - Up to 470 ft of quartz sand overlying the coal measures at Charleston has been recorded during drilling by the N.Z. Cement Co.

The maximum thickness of the purer resorted material which is mostly restricted to local areas of the coastal terraces, however, is not thought to greatly exceed 100 ft.

Large areas in excess of 70 ft are known to occur south of Nile River, and in excess of 30 ft at Little Totara River. The quantity of quartz sand with a silica content greater than say 80% would be measurable in terms of many millions of tons, that in excess of 90% silica would be appreciably less but still very great.

LUMP QUARTZ -- Lump quartz occurs in the form of small veins within the basement granite and greywacke, of the district, but has so far not been mined other than for its associated minerals. Possibly of more economic interest is its occurrence as translucent blocks up to 10 ft long within pegmatite intrusions into the gneiss of the Charleston area, for if these pegmatites were ever mined for their feldspar, beryl or mica content then it is possible that the quartz would also prove of value.

References:

HENDERSON, J. 1943: Fireclay and Ganister in N.Z. D.S.I.R. Bull. 88.

SCAHILL, T. E. J., SHANNON, W. T., 1964: A note on Foundry Moulding Properties of Sand from Charleston District, Westport. N.Z.J. Sci. 7 (3). 362-366.

YOUNG, D. J. 1964: Ganister and Silica Sand Deposits of the West Coast, South Island. N.Z.J. Geol. & Geophys. 7 (3). 508-524.

## Sulphur

The lignite deposits of the Charleston coalfield contain up to 6.5% sulphur as do some smaller areas of coal in the Buller Coalfield. As such they represent possible sulphur ore deposits.

References:

GRAHAM, J. I., HOPE, J. M., 1959: Suggestions for Utilisation of Buller Coal. Proc. 4th Triennial Min. Con. Dunedin, N.Z.

## TAXATION INCENTIVES

Various incentives are being offered to industry to become established in the Buller County. The most important of these are (a) Taxation Incentives and (b) Concession rates for the supply of electric power.

(a) Taxation Incentives:

1.) West Coast Development Allowance. An allowance of 20% on the cost of plant, machinery and buildings bought or installed, built or extended before 1st April, 1967. This allowance only applies to the West Coast of the South Island and includes Westport Borough and the Buller County. It means that over the life of the assets up to 120% of the cost can be written off.

2.) Special Depreciation. 20% depreciation is allowable on plant and machinery acquired, installed or extended before 1st April, 1966.

3.) Initial Depreciation. 20% depreciation allowance on the cost of buildings acquired or erected, for employee accommodation before 1st April, 1966 and first used for that purpose during the income year.

4.) Accelerated Depreciation on Research Equipment. Cost of plant, machinery and equipment acquired, installed or extended on or after 1st April, 1963 for scientific purposes directly relating to the business may be written off over 5 years.

5.) Scientific Research. A deduction of the cost of scientific research directly relating to the trade or business carried on by the taxpayer except on assets on which depreciation has been claimed.

6.) Export Market Development. An additional 50% deduction for income tax purposes for certain qualifying expenditure which must also be ordinarily deductible. Some examples are fares and accommo-

dation spent on trips overseas, research on marketing, packaging and producing new lines, advertising, securing publicity, securing business, free samples and tenders. At present this incentive is in force until 31st March, 1966.

7.) Increased Exports. When the value of goods exported during the year has increased by comparison with the average value of goods exported during a "base period" of three years, the proportion of net profit attributable to the increased exports is an allowable deduction.

OTHER CONCESSIONS

(b) Concession rates for the supply of electric power: The local electric power supply authority, which covers both the borough of Westport and the county of Buller is very anxious to encourage new industry to its area. It will offer concessional rates to all industries of sufficient size that have a high load factor. In addition to this, the Minister of Electricity now has legislative authority to reduce the price charged for electrical energy supplied and sold to a supply authority if he is satisfied -

1.) That the electrical energy will be resold at reduced rates to a person who proposes to establish a new industry or to expand an existing industry and

2.) That the establishment or expansion of the industry will be in the national interest and

3.) That an adequate supply of electrical energy at the reduced rates is necessary for the establishment or expansion of the industry. It only applies to new industries with a demand of at least 5000 K.W. and where the cost of power is a significant percentage of the cost of the finished article. - P. Roselli, public accountant, Westport.

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